
Space Weather Technical Forecast

Issued on Saturday 2 November 2024 at 01:08 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Moderate to High solar activity with M-flares expected, and a chance of further X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity was moderate with four M-flares, the largest of which was a M2.0 at 01/1431 UTC from AR3878 in the northeast. There are thirteen active regions, all now numbered with the new AR3881 developing in the southeast, and the collection of spots south of AR3876 re-numbered as AR3871. AR3878 remains the most active flare source with two delta spots visible within its larger trailer. AR3869 remains the most complex region within the cluster of spots in the southwest, with opposite polarity to what would be expected for a southern disc sunspot ("anti-Hale"), although the magnetic demarcation between this spot and surrounding regions is somewhat unclear. Most sunspots only showing slow evolution currently.

No Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds saw a decreasing trend from slightly elevated levels around 480km/s to current background speeds of around 390km/s, with the now declining influence of a transient CME which arrived at L1 around 01/0630UTC. Density was below average throughout. The Interplanetary Magnetic Field (IMF), Bt, was weak to moderate 6-10nT, peaking early in the period following transient arrival. The north-south component, Bz, varying weakly between -7nT and +8nT, but chiefly positive. Phi angle was negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp0-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at S1 Minor Radiation Storm to start, falling below the S1 threshold at 01/0855 UTC and falling to 4pfu by 02/0000 UTC. High energy electron flux (greater than 2MeV) observed by GOES16 was Background to Moderate. The associated 24-hour fluence was well below the Active threshold, with 4.68e6 integrated flux observed at 02/0000UTC.

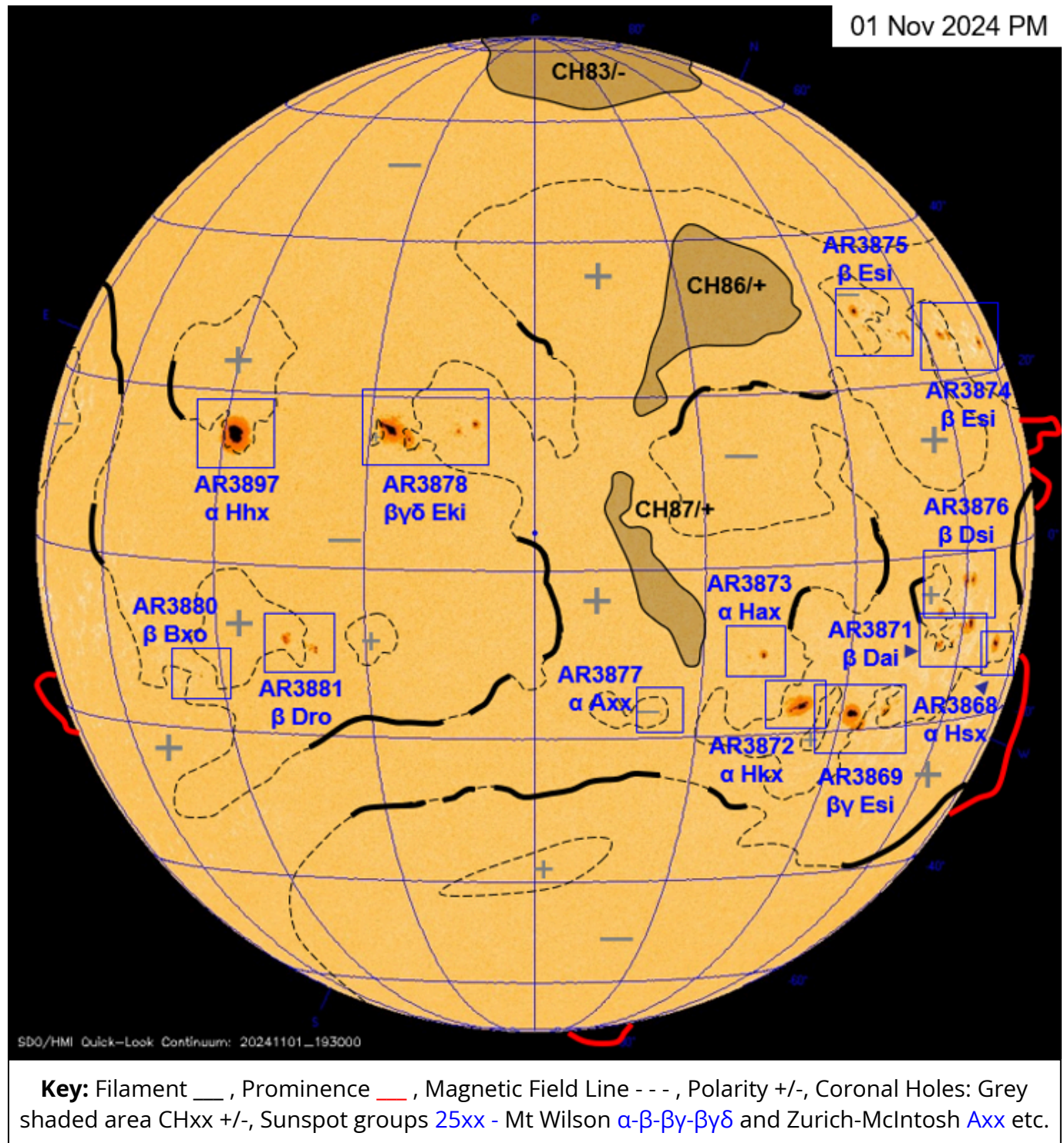
Four-Day Space Weather Forecast Summary

Solar Activity: Moderate or High activity is expected to continue into the start of the period, with occasional M-class flares expected and a chance of further isolated X-class flares. Into days 3-4 (04-05 Nov) flare risk perhaps reducing somewhat as active regions in the west begin to rotate off the visible disk.

Solar Wind / Geomagnetic Activity: A CME which left the sun during the 31st Nov has the potential to give a glancing blow to Earth late on day 2 (03 Nov) or into early day 3 (04 Nov). Quiet geomagnetic activity is expected initially. Activity expected to increase to become more generally Unsettled later into day 2 (03 Nov) and day 3 (04 Nov), with a chance of Active and a slight chance of G1 intervals given the risk of a glancing CME blow and HSS influence. Activity currently expected to be generally Quiet to Unsettled once again by day 4 (05 Nov).

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is now below the S1 Moderate Radiation Storm level, and continuing to slowly decline. However, any further notable flares bring a persistent chance for further enhancement during the period. The high energy electron flux is expected to be Background to Moderate, with the associated fluence forecast to persist below Active levels.

Figure 1: Solar Synoptic May Valid 01/1930 UTC.



Geomagnetic Storms

A CME which left the sun during the 31st Nov has the potential to give a glancing blow to Earth late on day 2 (03 Nov) or into early day 3 (04 Nov). This is low confidence however given a lack of imagery for analysis. These recent gaps in available coronagraph imagery, combined with the number of large filaments on the Earth-facing disc and the continued chance for notable flares, results in a CME forecast which has a greater than usual potential to change at short notice in the coming days.

Recent faster wind and transient CME influence has eased with solar winds returning to background levels. Into the period influence from CH86/+, or more likely CH87/+ to its south, may cause further enhancement back to slightly elevated or perhaps elevated levels through the later part of day 2 (02 Nov) or more likely into day 3 (04 Nov) . While these features are recurrent ones, both appear larger and more prominent on this rotation, which suggests that the current solar wind increase might be underestimated by the MOSWOC ENLIL model.

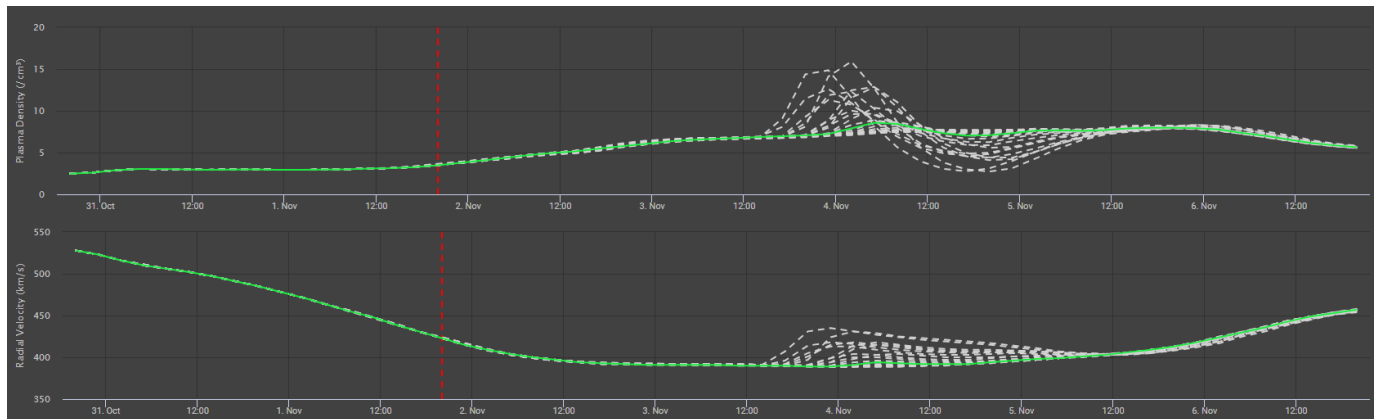
Quiet geomagnetic activity is expected initially. Activity expected to increase to become more generally Unsettled later into day 2 (03 Nov) and day 3 (04 Nov), with a chance of Active and a slight chance of G1 intervals given the risk of a glancing CME blow and HSS influence. Activity currently expected to be generally Quiet to Unsettled once again by day 4 (05 Nov) although forecast lower than usual confidence.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	20	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R $\odot$ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
31/1915	Partial	AR3877	central- southern disk	600	04/0300 +6hr	Low confidence, glancing blow.

Figure 2: Latest MOSWOC ENLIL ensemble output. Note slight glancing blow risk signaled, with the more general increase late in the period thought somewhat too late and not representative of CH86/87.



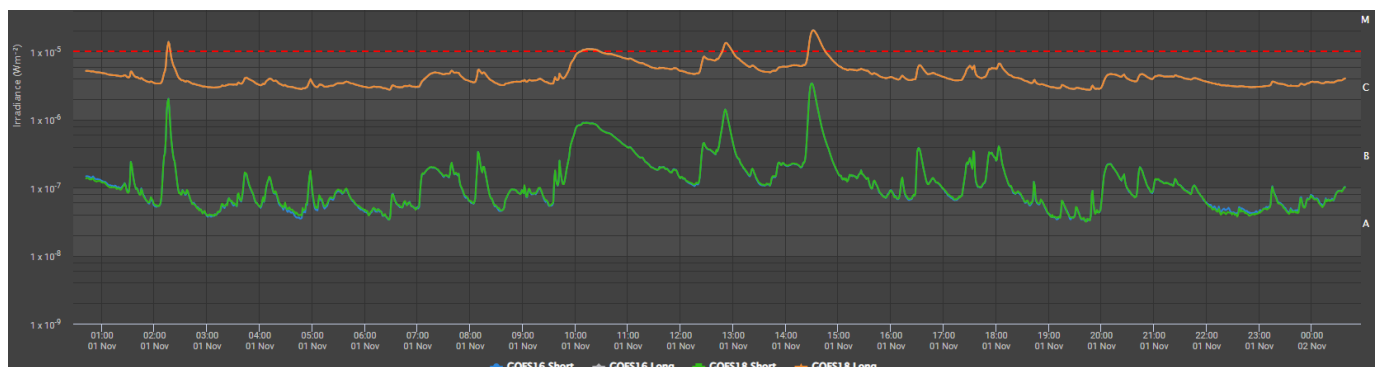
Radio Blackouts - X-Ray Flares

There visible disk remains highly populated with thirteen numbered active regions. AR3878 is statistically the most likely flare source, with two delta spots visible within its larger trailer, this is being born out with this region having now produced two X-class flares and the system appears conducive to further activity in the coming days. AR3869 is the most magnetically complex region within the cluster of spots in the southwest, it retains the opposite polarity to what would be expected for a southern disc sunspot ("anti-Hale"), although the magnetic demarcation between this spot and sounding regions is somewhat unclear. The most active regions in the southwest cluster are AR3876 and the newly re-numbered AR3871 to its south. These regions will be approaching the western limb by the end of the period. There remains other notable regions as well, with the two sunspots in the northwest, AR3874 and particularly AR3875, both presenting an ongoing risk of flares, with AR3874 also due to leave the visible disk later in the period.

Moderate or High activity is expected to continue initially, with occasional M-class flares expected and a chance of further isolated X-class flares. By day 3 (04 Nov) and into day 4 (05 Nov) regions leaving the western limb may see a slight decrease in the total flare risk, with recurrence and far-side sounding imagery not suggesting any significant oncoming regions. Therefore the flare risk reducing slightly into the period, although Moderate activity remains likely pending further developments.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	80	70	70
Very Active	R3-R5 (X Class)	No	25	25	20	20

Figure 3: Latest 24hr GOES16/18 X-Ray trace.



Solar Radiation Storms (High Energy Protons)

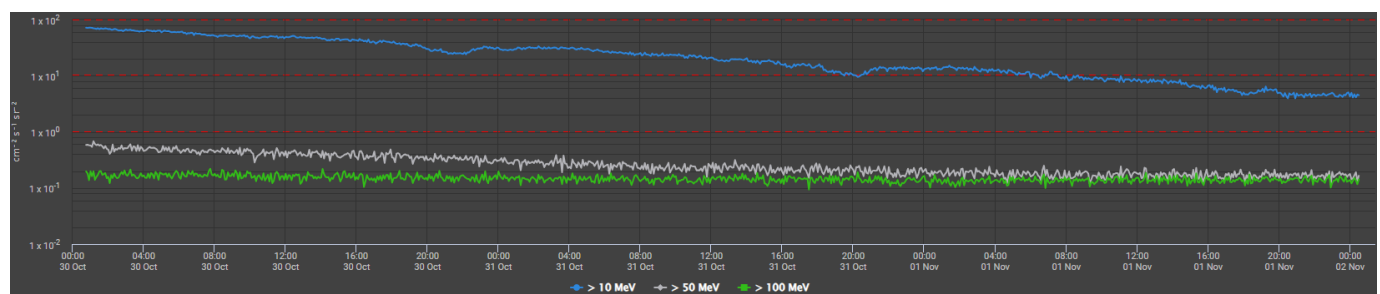
The recently elevated high energy proton flux at GOES-18 over previous days has now fallen below the S1 Minor Radiation storm level and is expected to decline towards background through days 1 and 2 (02-03 Nov) in the absence of further enhancement.

Further enhancements remain possible however, with the potential for notable flares from a number of the sunspots on the disc. This includes the cluster of regions in the western disc, all of which will remain in potentially geo-effective positions through the period even as some spots round the western limb. The proton risk associated with AR3878 will also only increase into the period as this region transits west, although only limited proton response has been diagnosed from the recent significant flares from this region.

Overall there is a persistent chance of further proton enhancement though the period, reducing slightly through the latter half as conditions likely continue to ease in the absence of further enhancement.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	Yes	30	30	25	25
Very Active	$\geq \text{S3}^*$	No	5	5	5	5
* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and/or $50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

Figure 4: 72hr GOES18 Proton trace, showing steady declining trend.



High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate enhancement expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times10^9$	No	1	1	1	1

Figure 5: Latest MOSWOC REFM output.

